(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 January 2001 (25.01.2001)

PCT

(10) International Publication Number
WO 01/06724 A2

(51) International Patent Classification[7]: H04L 27/00

(21) International Application Number: PCT/US00/40382

(22) International Filing Date: 14 July 2000 (14.07.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

60/144,307	16 July 1999 (16.07.1999)	US
60/144,491	19 July 1999 (19.07.1999)	US
60/144,723	20 July 1999 (20.07.1999)	US
09/616,135	13 July 2000 (13.07.2000)	US

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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

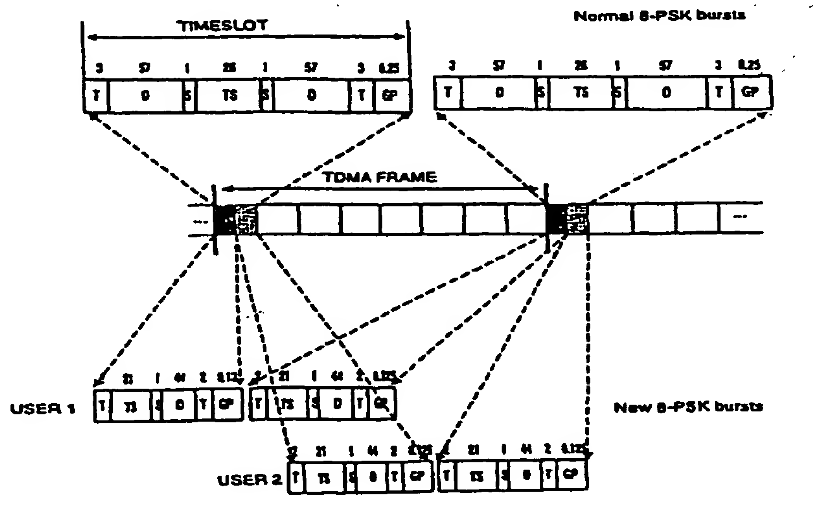
(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— *Without international search report and to be republished upon receipt of that report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: OPTIMIZED BURST STRUCTURE FOR EDGE 8-PSK SPEECH



Timeslot and format of burst

(57) Abstract: A method for optimizing a burst structure in a communication system. The method comprising the steps of: providing a plurality of at least two independent data structures having a total time slot interval of substantially 577 microseconds; and transmitting the at least two data structures between a mobile station and a base station of the communication system.

WO 01/06724 A2

OPTIMIZED BURST STRUCTURE FOR EDGE 8-PSK SPEECH

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 60/144,307, filed 7/16/99, Application No. 60/144,491, filed 7/19/99, and Application No. 60/144,723, filed 7/20/99, which are herein incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to radiotelephones and radio telephone systems and, in particular, to time division multiple access (TDMA) cellular radio telephones, mobile stations radio communication systems and networks and further more to Enhanced Data Rate for GSM (EDGE) Circuit Switched (CS) and Packet Switched (PS) connections.

2. Prior Art

The following publications are hereby incorporated by reference in their entireties:

[1] "Physical layer on the radio path", GSM 05.01 version 6.1.1 Release 1997.

[2] ETSI SMG2, "Introduction of ECSD/EDGE in 05.03", Tdoc 699/99.

[3] "Support for variable-rate circuit switched bearer services in TDMA" Patent Application EP 96922914 having Publication Number EP 98/0838107.

[4] "A method and a system for optimal utilization of the data communication capacity in a cellular radio system", Patent Application: EP 98309333, Publication Number 99/0917321.

[5] "A method and arrangement for locating a mobile station", Patent Application EP 98660112 Publication Number EP 98/0933961.

[6] "Digital Cellular Telecommunications System (Phase 2+; Enhanced Data Rates For GSM Evolution (EDGE) Project Scheduling And Open Issues For EDGE (GSM 10.59, Version 1.11.0), European Telecommunications Standards Institute, March 2, 1999.

[7] "Digital Cellular Telecommunications System (Phase 2+); General Packet Radio Service (GPRS); Service Description; Stage 2 (GSM 03.60 Version 6.7.0 Release 1997) European Telecommunications Standards Institute, March 1999.

The currently known EDGE radio telephones and radio telephone systems use modulation techniques in order to evolve data services in GSM; reusing as much of the physical layer as possible.

An EDGE phase 1 system provides single and multi slot packet switched services and single and multi slot circuit switched services below 64kbit/s. In an EDGE phase 2 system other services not included in phase 1 employ the new modulation techniques of base station sub-system (BSS). From a function point of view the EDGE concept includes packet switched data and circuit switched data [GSM 10.59 version 1.11.0].

The packet switched data of EDGE is known as Enhanced General Packet Radio Service (EGPRS), , which is known as GSM phase 2+GPRS service and is described generally from an architecture point of view in GSM 03.60. The circuit switched data of EDGE is enhanced HSCSD, High Speed Circuit Switched Data, which is described in GSM 03.34.

In the EDGE Phase 1 standard, an 8-PSK burst format for ECSD and EGPRS services has been defined. The structure of the 8-PSK burst is shown in Fig. 1. The length of the normal 8-PSK burst symbols for both ECSD and GPRS is 156.25 symbols (8-PSK), the burst structure of ECSD containing 6 tail symbols (T), 114 data symbols (D), 2 signaling symbols (S), 26 training symbols (TS), and the guard period (GP) of length 8.25 [1] [2].

The current EDGE 8-PSK burst format for both circuit switched (CS) and packet switched (PS) has a payload of 68.4 kbps. For normal quality speech service a payload

this large causes poor frequency and interference diversity. Thus speech capacity is actually decreased. The deterioration of the speech quality is more evident with half rate or lower rate (e.g. quarter rate) channel modes when the diversity is further reduced.

Alternative attempts to solve the problem of the too large payload unit include:

(1) Improve the robustness of the speech payload by filling the rest of the payload with channel coding. E.g. for the full rate channel and assuming a 12 kbps speech codec output rate this would mean rate 1/5...1/6 code. This would make the channel robust but on the other hand one speech user would occupy the whole EDGE 8PSK slot, which cannot lead to good spectral efficiency [3].

(2) The payload of an 8-PSK burst is shared by two or more users. This could be an acceptable approach in down-link where the power control dynamic range is not very large. Also the network can alleviate the power control problem by using a clever strategy in resource allocation, i.e. allocating users close to each other to the same time slot. In addition to the power control, this approach would lead to difficulties with smart antennas. In up-link mode, the resulting power control problems would render this approach impractical [4].

(3) Defining lower rate channels by defining channel modes such as, for example, half rate, third rate, quarter rate and so on while using the standard GSM frame structure. However, this leads to small interleaving

depth, which reduces the performance due to the poor diversity.

SUMMARY OF THE INVENTION

The invention is directed to a method for optimizing a burst structure in a communication system. The method comprising the steps of: providing a plurality of at least two independent data structures having a total time slot interval of substantially 577 microseconds; and transmitting the at least two data structures between a mobile station and a base station of the communication system.

In accordance with another method of the present invention, a method of transmitting signals in a communication system is provided. The method comprising the steps of: providing symbols in a burst structure having a symbol length that is less than 156.25 symbols; and transmitting the symbols in the burst structure between a mobile station and a base station of the radio telephone communication system.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing aspects and other features of the present invention are explained in the following description, taken in connection with the accompanying drawings, wherein:

Fig. 1 illustrates a conventional 8 PSK burst structure;

Fig. 2 is a perspective view of a mobile station and a cellular communication system to which the mobile station is bidirectionally coupled through a wireless RF link;

Fig. 3 is a block diagram of the mobile station shown in Fig. 2 that is constructed and operated in accordance with this invention;

Fig. 4 is a logical wiring diagram of a signaling and data transfer interface that is constructed and operated in accordance with this invention;

Fig. 5 is a network diagram of a packet data network that is constructed and operated in accordance with this invention;

Fig. 6 is a schematic diagram of a 8-PSK burst structure illustrating one embodiment of the current invention;

Fig. 7 is a schematic diagram of a 8-PSK burst structure illustrating an alternate embodiment of the current invention;

Fig. 8 is a schematic diagram illustrating the relationship between an embodiment of the current invention and a conventional 8-PSK format;

Fig. 9 is a relational diagram showing the mappings between conventional 8-PSK bursts and one embodiment of the current invention in half rate (HR') and full rate (FR') speech modes; and

Fig. 10 is a method flow chart showing the steps for creating two independent burst structures that will fit within a 577 microsecond burst window.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Although the present invention will be described with reference to the single embodiment shown in the drawings, it should be understood that the present invention can be embodied in many alternate forms of embodiments.

This invention defines a payload unit for the EDGE/8-PSK physical layer, which is suitable for low rate real-time services, e.g. voice. The length of the new 8-PSK burst is half of the conventional 8-PSK burst length. With the new 8-PSK burst and half rate mode, four users per normal time slot can be supported. This enhances the speech capacity even though the coverage area of the 8-PSK modulated bursts is somewhat restricted to GMSK modulated bursts.

Figs. 2 and 3 are shown for illustrating a wireless user terminal or mobile station 10, such as but not limited to a cellular radiotelephone or a personal communicator, that is suitable for practicing this invention. The mobile station 10 includes an antenna 12 for transmitting signals to and for receiving signals from a base site or base station 30, which is assumed to include a base station sub-system (BSS) as well as a base transceiver station (BTS). For simplicity, these two components are collectively referred to simply as the base station 30. After the mobile has attached to the network and initiated an access request to the network and the appropriate dedicated connections are reserved for the mobile station (MS) and the circuit connection between MS and the connected party has been established the circuit switched data transferred from mobile station (MS) to the

network is received in the BTS in which cell the subscriber is camping. The circuit switched data e.g. voice or real time data is conveyed to hierarchically upper network elements of BSS such as BSC, base station Controller. The payload is transferred receiving signals from a base site BSS to visited mobile switch (MSC) and depending on the called number among others the call data may be transferred further to PSTN, Public Switched Telephone Network via the gateway section (GMSC) of the MSC. The connection and circuit switched data transfer functions to the opposite direction via the same network elements but instead of Mobile Station (MS) initiating access request to the network the MS is paged when terminating connection need to be created to the receiving MS. With general regard to GSM mobile stations and networks, reference can be had to "The GSM System for Mobile Communications", by Michel Mouly and Marie-Bernadette Pautet, 1992, the disclosure of which is incorporated by reference in its entirety.

Reference is made to Figs. 4. General Packet Radio Service (GPRS) is logically implemented on the GSM structure through the addition of two network nodes, the Serving GPRS Support Node and the Gateway Support Node. It is necessary to name a number of new interfaces. No inference should be drawn about the physical configuration on an interface from Fig. 4. A GPRS Support Node (GSN) contains functionality required to support GPRS. In one Public Land Mobile Network (PLMN), there may be more than one GSN.

In order to access the packet data GPRS services, an MS is connected to the network by conventional means;

establishing a logical link between the MS and the Serving GPRS Support Node, SGSN. In order to send and receive data, the MS activates the packet data address, which in a voice service case may be the Mobile Station ISDN number (MSISDN) of the recipient party; and as a result of this recipient address activation connection to a corresponding Gateway GPRS Support Node (GGSN) is established.

The Gateway GPRS Support Node (GGSN) is the node that is accessed by the packet data network due to evaluation of the PDP address. It contains routing information for attached GPRS users. The routing information is used to tunnel Protocol Data Units (PDUs) to the MS's current point of attachment, i.e., the Serving GPRS Support Node. The GGSN may request location information from the Home Location Register (HLR) via the optional Gc interface. The GGSN is the first point of PDN interconnection with a GSM PLMN supporting GPRS (i.e., the Gi reference point is supported by the GGSN).

The Serving GPRS Support Node (SGSN) is the node that is serving the MS (i.e., the Gb interface is supported by the SGSN). At GPRS attach, the SGSN establishes a mobility management context containing information pertaining to e.g., mobility and security for the MS. At PDP Context Activation, the SGSN establishes a PDP context, to be used for routing purposes, with the GGSN that the GPRS subscriber will be using.

The functionality of SGSN and GGSN may be combined in the same physical node, or they may reside in different physical nodes. SGSN and GGSN contain IP routing

functionality, and they may be interconnected with IP routers. When SGSN and GGSN are in different PLMNs, they are interconnected via the Gp interface. The Gp interface provides the functionality of the Gn interface, plus security functionality required for inter-PLMN communication. The security functionality is based on mutual agreements between operators.

The SGSN may send location information to the Mobile Switch/Visitor Location Register (MSC/VLR) via the optional Gs interface. The SGSN may receive paging requests from the MSC/VLR via the Gs interface.

Referring also to Fig. 5, there are two kinds of GPRS backbone networks. These are called intra-PLMN backbone network; and inter-PLMN backbone network. The intra-PLMN backbone network is the IP network interconnecting GSNs within the same PLMN. The inter-PLMN backbone network is the IP network interconnecting GSNs and intra-PLMN backbone networks in different PLMNs. Every intra-PLMN backbone network is a private IP network intended for GPRS data and GPRS signalling only. A private IP network is an IP network to which some access control mechanism is applied in order to achieve a required level of security. Two intra-PLMN backbone networks are connected via the Gp interface using Border Gateways (BGs) and an inter-PLMN backbone network. The inter-PLMN backbone network is selected by a roaming agreement that includes the BG security functionality. The BG is not defined within the scope of GPRS. The inter-PLMN backbone can be a Packet Data Network, e.g., the public internet or a leased line.

The HLR contains GPRS subscription data and routing information. The HLR is accessible form the SGSN via the Gr interface and from the GGSN via the Gc interface. For roaming MSs, HLR may be in a different PLMN than the current SGSN.

The SMS-GMSC and SMS-IWMSC are connected to the SGSN via the Gd interface to enable GPRS MSs to send and receive Short Messages (SMs) over GPRS radio channels.

A GPRS MS can operate in one of three modes of operation as listed below. The mode of operation depends on the services that the MS is attached to (i.e., only GPRS or both GPRS and other GSM services) and upon the MS's capabilities to operate GPRS and other GSM services simultaneously.

Class-A mode of operation: The MS is attached to both GPRS and other GSM services, and the MS supports simultaneous operation of GPRS and other GSM services.

Class-B mode of operation: The MS is attached to both GPRS and other GSM services, but the MS can only operate one set of services at a time. In network operation mode III (see sub-clause "Paging Co-ordination"), an MS that is capable of monitoring only one paging channel at a time cannot operate in class B mode of operation. In this case, such an MS shall revert to class-C mode of operation.

Class-C mode of operation: The MS is exclusively attached to GPRS services.

Other GSM technical specifications may refer to the MS modes of operation as GPRS class-A MS, GPRS class-B MS, and GPRS class-C MS.

The currently defined lower layers of packet data of EDGE GPRS is described in the GSM 03.64 specification and for high speed circuit switched data of EDGE is described in GSM 3.52, which are based on TDMA of GSM. More detailed radio interface specifications are referred from those specifications to GSM 05-series of which 05.01 titled as "Physical Layer on the Radio Path General Description", which among others includes basic definition of time slot and burst structure.

GSM 05.02 describes burst building, and burst multiplexing, GSM 05.03 describes the channel coding reordering and partitioning, and interleaving, GSM 05.04 describes the differential encoding, and modulation just to mention some of the current GSM EDGE Standards of the physical radio layer of GSM phase 2+.

Referring now to Fig. 3, a user interface of the MS connectable to a GSM type network may include a conventional earphone or speaker 17, a conventional microphone 19, a display 20, and a user input device, typically a keypad 22, all of which are coupled to the controller 18. The keypad 22 includes the conventional numeric (0-9) and related keys (#,*) 22a, and other keys 22b used for operating the mobile station 10. These other keys 22b may include, by example, a SEND key, various menu scrolling and soft keys, and a PWR key. The mobile station 10 also includes a battery 26 for powering

the various circuits that are required to operate the mobile station. The MS 10 also includes various memories, shown collectively as the memory 24, wherein are stored a plurality of constants and variables that are used by the controller 18 during the operation of the MS. The MS includes a modulator (MOD) 14A, a transmitter 14, a receiver 16, a demodulator (DEMOD) 16A, and a controller 18 that provides signals to and receives signals from the transmitter 14 and receiver 16, respectively. These signals include signaling information in accordance with the air interface standard of the applicable cellular system of EDGE GSM, and also the user originated payload such as voice and data in real-time (RT) or non-real-time mode (NRT). It is understood that the controller 18 also includes the circuitry required for implementing the audio and logic functions of the mobile station.

By way of example, the controller 18 may be comprised of a digital signal processor device, a microprocessor device, and various analog to digital converters, digital to analog converters, and other support circuits. The control and signal processing functions of the MS are allocated between these devices according to their respective capabilities.

Referring now to Figs 2 and 3, certain TDMA timing related parameters that are transmitted from the BS 30 to the MS 10, are typically stored in the memory 24 for use by the controller 18. It should be understood that the mobile station 10 can be a vehicle mounted or a handheld device or even a stationary device such as in an office local loop. It should further be appreciated that the

mobile station 10 can be capable of operating with one or more air interface standards, modulation types, and access types, and may thus be dual (or higher) mode device.

Referring now to Fig. 6, there is shown one embodiment of the current invention. The length of the new 8-PSK burst shown in Fig. 2 is 78.125 symbols, which is half of normal 8-PSK burst length. The new 8-PSK burst contains 4 tail symbols (T), 21 training symbols (TS), 1 signaling symbol (S), 44 data symbols (D) and the guard period (GP) of length 8.125 symbols.

Referring now to Fig. 10 there is shown a method flow chart showing the steps for creating two independent burst structures that will fit within a 577 microsecond burst window; the normal 8-PSK burst length. At 30 the user defines two independent burst structures where the total time of the burst structures will equal 577 microseconds (i.e., a normal 8-PSK burst time). At 32 each burst structure is divided into at least two time intervals with one of the intervals, generally the last being designated at 34 as the guard portion interval. The non-guard intervals are populated at 36 with data as appropriate and transmitted at 38.

The training sequence can reside either as preamble at the beginning of the burst (after tail symbols) or as a mid-amble between the data fields (Fig. 7) as in current GSM and EDGE 8PSK normal bursts. The preamble is advantageously in the short burst, where the burst length is so short that the channel estimate which is based on

the training sequence is still rather accurate even for the furthest data symbols. The preamble type training sequence makes it possible to run the equalizer only in one direction (instead of two).

This embodiment of the 8-PSK burst structure can be seen as an example of one embodiment of the invention. Other embodiments may vary the structure to address alternate transmission reception issues. For example, if the resolution of the sampling rate is an issue, the 8-PSK burst structure can be designed so that in the first (User 1) new 8-PSK burst, the guard period length is 8 symbols, and in the second (User 2) 8-PSK burst, the guard period is 8.25 symbols.

In this manner the User 1 burst having a length of 78 symbols and the second User 2 burst having a length of 78.25 symbols have different burst length when compared to each other; but when combined have the same length as the normal 8-PSK burst (i.e., 156.25 symbols).

Fig. 8 shows how one embodiment of the invention is mapped to the current GSM/EDGE time slot and TDMA frame structure. One can call the space (or time slot) occupied by the 8-PSK burst a mini-slot which is half of the size of the normal GSM time slot.

With one embodiment of the invention, two full rate (FR') users can use the same normal size time slot instead of a one normal FR user. For example, Fig. 9 shows how four new burst users can use half rate (HR') speech mode instead of two normal HR users.

The following possible mappings of the old and new channel modes are shown in Fig. 9:

(1) Normal full rate speech (FR), diagonal interleaving using normal bursts over 8 consequent TDMA frames. One user per normal slot.

(2) Normal half rate speech (HR), diagonal interleaving using normal bursts over 4 alternating TDMA frames (every other frame). Two users per normal slot.

(3) New full rate speech (FR'), diagonal interleaving using new 8-PSK bursts over 8 consequent TDMA frames. Two users per normal slot.

(4) New half rate speech (HR'), diagonal interleaving using new 8-PSK bursts over 4 consequent TDMA frames. Four users per normal slot.

(5) New full rate speech (FR'), rectangular interleaving using two consequent new 8-PSK bursts over 4 consequent TDMA frames. The other full rate (FR') user will occupy the next four frames. Two users per normal slot.

(6) New half rate speech (HR'), rectangular interleaving using two consequent new 8-PSK bursts over 2 consequent TDMA frames. The other half rate (HR') users (User 2, 3 and 4) occupy the next six frames, one at a time. Four users per normal slot.

(7) Two new full rate speech channels allocated to one user. Alternatively, combining two FR' channels instead of changing to normal 8-PSK FR channel.

An advantage of this invention where multiple low rate users are multiplexed to one physical burst is that power control can be applied normally because each user is allocated its own time (mini)slot. The MS location employs an embodiment of the invention in an up-link mode while the down-link mode uses conventional 8-PSK burst structure and applies normal power control [5].

A further advantage is that the effective interleaving depth becomes longer. This has a significant impact on the layer 1 performance of low rate users in EDGE. The interleaving diversity is improved especially when frequency hopping is applied. However, also without frequency hopping, the varying interference from other co-channel users will improve the performance while the interleaving depth is longer.

This new mini-slot and burst structure can be considered as a general physical channel for low rate real-time services, independent of whether the radio interface is circuit switched or packet switched.

Although the field of the invention is GSM EDGE 8-PSK radio interface burst format and how the currently defined circuit switched enhanced HSCSD (also known as ECSD) may be altered to better support voice service, the invention is not limited to ECSD. An additional embodiment of the invention is the new burst length of the enhanced GPRS for real-time voice service.

This invention defines a new 8-PSK burst structure applicable to any type of EDGE-8 PSK speech in circuit switched (CS) or packet switched (PS) systems. The new EDGE 8-PSK structure provides improved frequency and interference diversity and allows independent power control for each user. In specifying any speech transfer for EDGE 8-PSK channels - either circuit switched or packet switched - it is beneficial from both a quality and a spectral efficiency point of view to define a shorter burst format which is tailored for typical speech bit rates and thus allows larger interleaving depth. The shorter burst provides good frequency and interference diversity and allows independent power control for each speech user. In addition to full rate speech, the invention can be implemented in lower rate channel modes (e.g., half rate) to further enhance speech capacity. The gross data rate of the full rate channel with the invention's shorter burst format is also adequate for providing high quality voice communication with wide-band speech codecs. The present invention can be used for GSM and Enhanced GSM carrier systems.

It should be understood that the foregoing description is only illustrative of the invention. Various alternatives and modifications can be devised by those skilled in the art without departing from the invention. For example, the invention is applicable to both the work for real-time (E) GPRS radio interface as well as for the EDGE AMR work. In addition, this invention may also be applied to IS-136HS indoor component, Wide-band TDMA, where a 1/64th slot (of the TDMA frame length) is defined particularly for speech. Accordingly, the present invention is intended to embrace all such alternatives, modifications

and variances which fall within the scope of the appended claims.

CLAIMS

What is claimed is:

1. A method of transmitting signals in a communication system, the method comprising the steps of:

providing symbols in a burst structure having a symbol length that is less than 156.25 symbols; and

transmitting the symbols in the burst structure between a mobile station and a base station of the radio telephone communication system.

2. A method as in claim 1 wherein the step of providing symbols in a burst structure further comprises the step of:

providing symbols in an 8-PSK burst structure.

3. A method as in claim 1 where in the step of providing symbols in a burst structure further comprises the step of:

providing the burst structure with a length of 78.125 symbols.

4. A method as in claim 3 wherein the step of providing the burst structure with the length of 78.125 symbols further comprises the steps of:

providing 2 symbols designated as first tail portion;

providing 21 symbols designated as a training sequence portion following the first tail portion;

providing 1 symbol designated as a signal flag portion following the training sequence portion;

providing 44 symbols designated as a data portion following the signal flag portion;

providing 2 symbols designated as a second tail portion following the data portion; and

providing 8.125 symbols designated as a guard portion following the second tail portion.

5. A method as in claim 3 wherein the step of providing the burst structure with the length of 78 symbols further comprises the steps of:

providing 2 symbols designated as first tail portion;

providing 22 symbols designated as a first data portion following the first tail portion;

providing 1 symbol designated as a signal flag portion following the first data portion;

providing 21 symbols designated as a training sequence portion following the signal flag portion;

providing 22 symbols designated as a second data portion following the training sequence portion;

providing 2 symbols designated as a second tail portion following the second data portion; and

providing 8 symbols designated as a guard portion following the second tail portion.

6. A method for optimizing a burst structure in a communication system, the method comprising the steps of:

providing a plurality of at least two independent data structures having a total time slot interval of substantially 577 microseconds; and

transmitting the at least two data structures between a mobile station and a base station of the communication system.

7. A method as in claim 6 wherein the step of providing the plurality of independent data structures having a total time slot interval of substantially 577 microseconds further comprises the steps of:

defining a first one of the plurality of independent data structures as having at least two time slot intervals wherein the at least two time slot intervals within the first one of the plurality of independent data structures substantially equals 288.28 microseconds; and

defining a second one of the plurality of independent data structures as having at least two time slot intervals wherein the at least two time slot intervals within the second one of the plurality of independent data structures substantially equals 288.28 microseconds.

8. A method as in claim 7 wherein the step of defining the first one of the plurality of independent data structures as having at least two time slot intervals further comprises the step of:

defining the first one of the plurality of independent data structures as having six time slot intervals.

9. A method as in claim 8 wherein the step of defining the first one of the plurality of independent data structures as having six time slot intervals further comprises the step of:

defining a first one of the six time slot intervals as substantially 7.38 microseconds;

defining a second one of the six time slot intervals as substantially 77.49 microseconds, wherein the second one of the six time slot intervals follows the first one of the six time slot intervals;

defining a third one of the six time slot intervals as substantially 3.69 microseconds, wherein the third one of the six time slot intervals follows the second one of the six time slot intervals;

defining a fourth one of the six time slot intervals as substantially 162.36 microseconds, wherein the fourth one of the six time slot intervals follows the third one of the six time slot intervals;

defining a fifth one of the six time slot intervals as substantially 7.38 microseconds, wherein the fifth one of the six time slot intervals follows the fourth one of the six time slot intervals; and

defining a sixth one of the six time slot intervals as substantially 29.98 microseconds, wherein the sixth one of the six time slot intervals follows the fifth one of the six time slot intervals.

10. A method as in claim 7 wherein the step of defining the second one of the plurality of independent data structures as having at least two time slot intervals further comprises the step of:

defining the second one of the plurality of independent data structures as having six time slot intervals.

11. A method as in claim 10 wherein the step of defining the second one of the plurality of independent data structures as having six time slot intervals further comprises the step of:

defining a first one of the six time slot intervals as substantially 7.38 microseconds;

defining a second one of the six time slot intervals as substantially 77.49 microseconds, wherein the second one of the six time slot intervals follows the first one of the six time slot intervals;

defining a third one of the six time slot intervals as substantially 3.69 microseconds, wherein the third one of the six time slot intervals follows the second one of the six time slot intervals;

defining a fourth one of the six time slot intervals as substantially 162.36 microseconds, wherein the fourth one of the six time slot intervals follows the third one of the six time slot intervals;

defining a fifth one of the six time slot intervals as substantially 7.38 microseconds, wherein the fifth one of the six time slot intervals follows the fourth one of the six time slot intervals; and

defining a sixth one of the six time slot intervals as substantially 29.52 microseconds, wherein the sixth one of the six time slot intervals follows the fifth one of the six time slot intervals.

12. A method as in claim 7 wherein the step of defining the first one of the plurality of independent data structures as having at least two time slot intervals further comprises the step of:

defining the first one of the plurality of independent data structures as having seven time slot intervals.

13. A method as in claim 12 wherein the step of defining the first one of the plurality of independent data structures as having seven time slot intervals further comprises the step of:

defining a first one of the seven time slot intervals as substantially 7.38 microseconds;

defining a second one of the seven time slot intervals as substantially 81.18 microseconds, wherein the second one of the six time slot intervals follows the first one of the six time slot intervals;

defining a third one of the seven time slot intervals as substantially 3.69 microseconds, wherein the third one of the six time slot intervals follows the second one of the six time slot intervals;

defining a fourth one of the seven time slot intervals as substantially 77.49 microseconds,

wherein the fourth one of the six time slot intervals follows the third one of the six time slot intervals;

defining a fifth one of the seven time slot intervals as substantially 81.18 microseconds, wherein the fifth one of the six time slot intervals follows the fourth one of the six time slot intervals;

defining a sixth one of the seven time slot intervals as substantially 7.38 microseconds, wherein the sixth one of the six time slot intervals follows the fifth one of the six time slot intervals; and

defining a seventh one of the seven time slot intervals as substantially 29.98 microseconds, wherein the seventh one of the seven time slot intervals follows the sixth one of the seven time slot intervals.

14. A method as in claim 7 wherein the step of defining the second one of the plurality of independent data structures as having at least two time slot intervals further comprises the step of:

defining the second one of the plurality of independent data structures as having seven time slot intervals.

15. A method as in claim 12 wherein the step of defining the second one of the plurality of independent data structures as having seven time slot intervals further comprises the step of:

defining a first one of the seven time slot intervals as substantially 7.38 microseconds;

defining a second one of the seven time slot intervals as substantially 81.18 microseconds, wherein the second one of the six time slot intervals follows the first one of the six time slot intervals;

defining a third one of the seven time slot intervals as substantially 3.69 microseconds, wherein the third one of the six time slot intervals follows the second one of the six time slot intervals;

defining a fourth one of the seven time slot intervals as substantially 77.49 microseconds, wherein the fourth one of the six time slot intervals follows the third one of the six time slot intervals;

defining a fifth one of the seven time slot intervals as substantially 81.18 microseconds, wherein the fifth one of the six time slot intervals follows the fourth one of the six time slot intervals;

defining a sixth one of the seven time slot intervals as substantially 7.38 microseconds, wherein the sixth one of the six time slot intervals follows the fifth one of the six time slot intervals; and

defining a seventh one of the seven time slot intervals as substantially 29.98 microseconds,

wherein the seventh one of the seven time slot intervals follows the sixth one of the seven time slot intervals.

16. A system adaptable to communicate with a base station, the system comprising:

the base station;

at least one mobile station adapted to communicate with the base station; and

an optimized burst structure for communication between the base station and the at least one mobile station, said burst structure providing improved frequency and interference diversity and independent power control for said at least one mobile station.

17. A system as in claim 16 wherein the optimized burst structure comprises a burst structure having a symbol length that is less than 156.25 symbols.

18. A system as in claim 17 wherein the burst structure is 78.125 symbols.

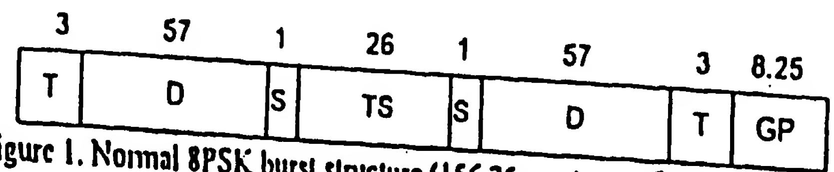


Figure 1. Normal 8PSK burst structure (156.25 sym) PRIOR ART

T= TAIL BITS
D = DATA BITS
S = SIGNAL FLAG
Ts = TRAINING SEQUENCE
GP = GUARD PORTION

FIG. 2

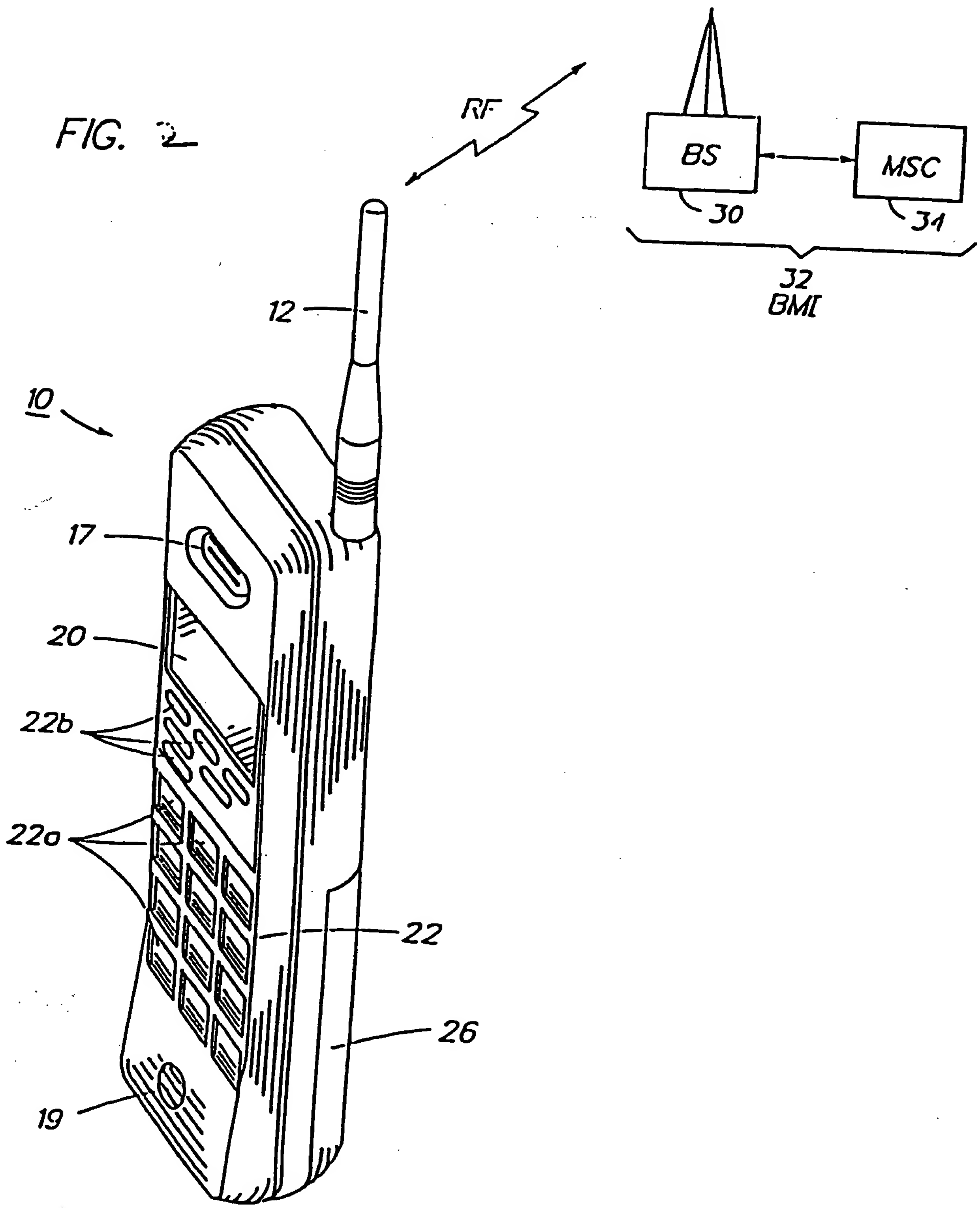


FIG. 3

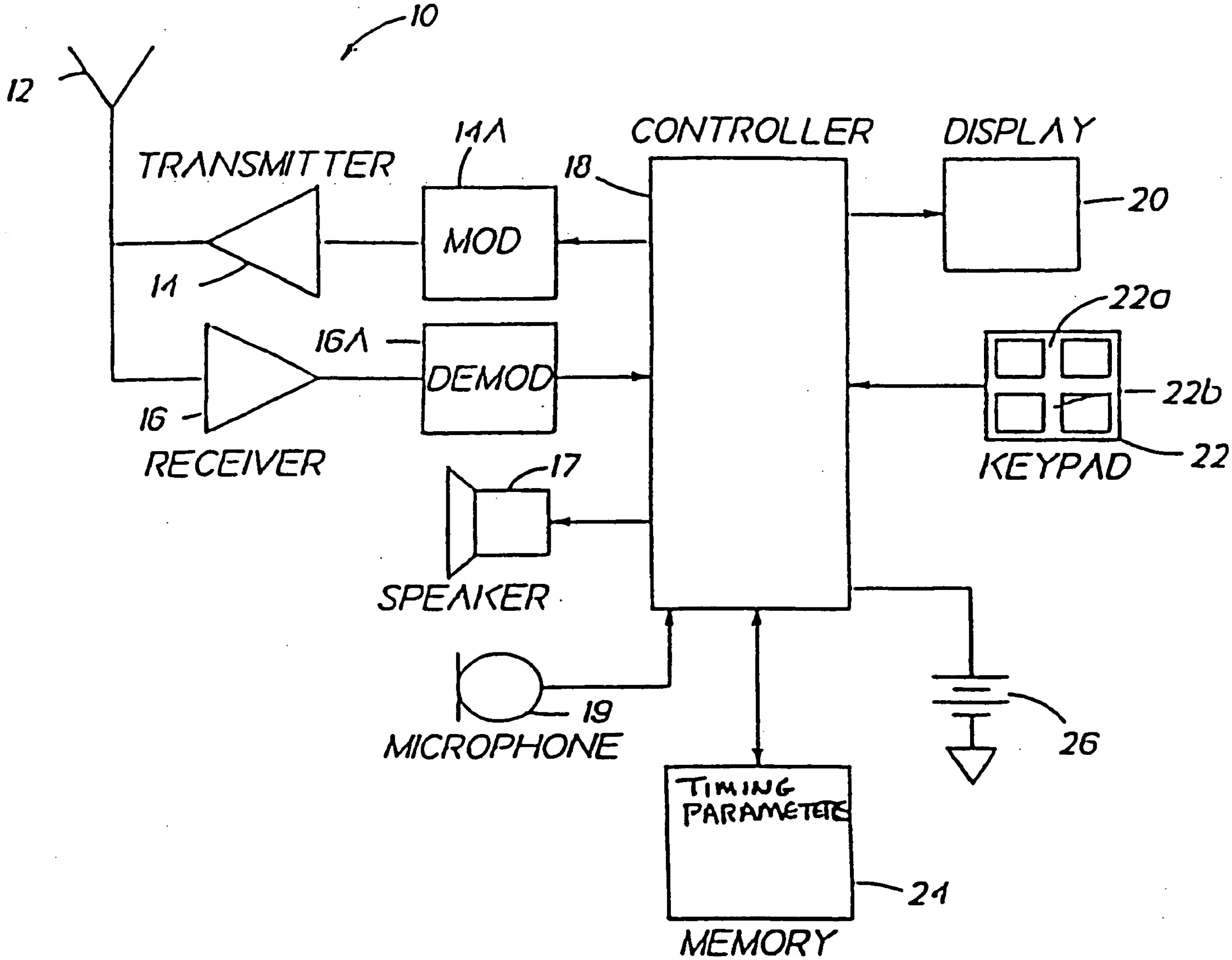

10
12
TRANSMITTER
14A
18
CONTROLLER
DISPLAY
MOD
20
14
22a
16A
DEMOD
22b
16
RECEIVER
17
KEYPAD
22
SPEAKER
19
MICROPHONE
26
TIMING PARAMETERS
24
MEMORY

FIG. 4

PRIOR ART

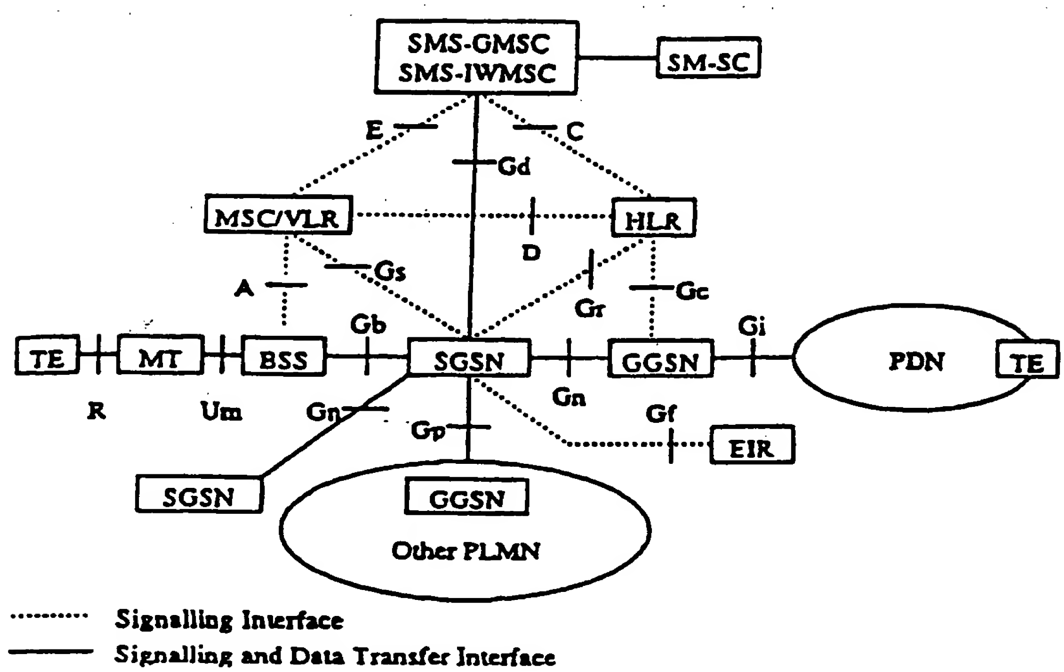
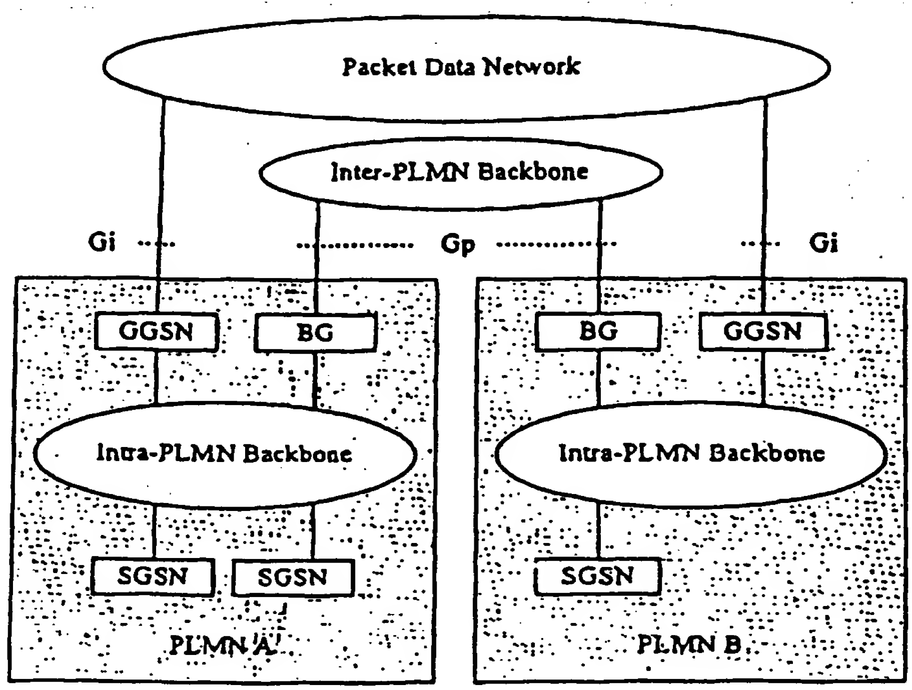
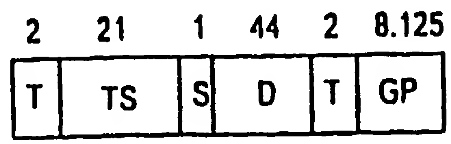


FIG. 5

PRIOR ART





T= TAIL BITS
D= DATA BITS
S = SIGNAL FLAG
TS = TRAINING SEQUENCE
GP = GUARD PORTION

Figure 6 New 8-PSK burst structure (78.125 sym)

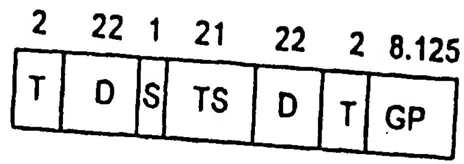


Figure 7. New 8-PSK burst structure with two separated data fields (78.125 sym)

T = TAIL BITS
D = DATA BITS
S = SIGNAL FLAG
Ts = TRAINING SEQUENCE
Gp = GUARD SEQUENCE

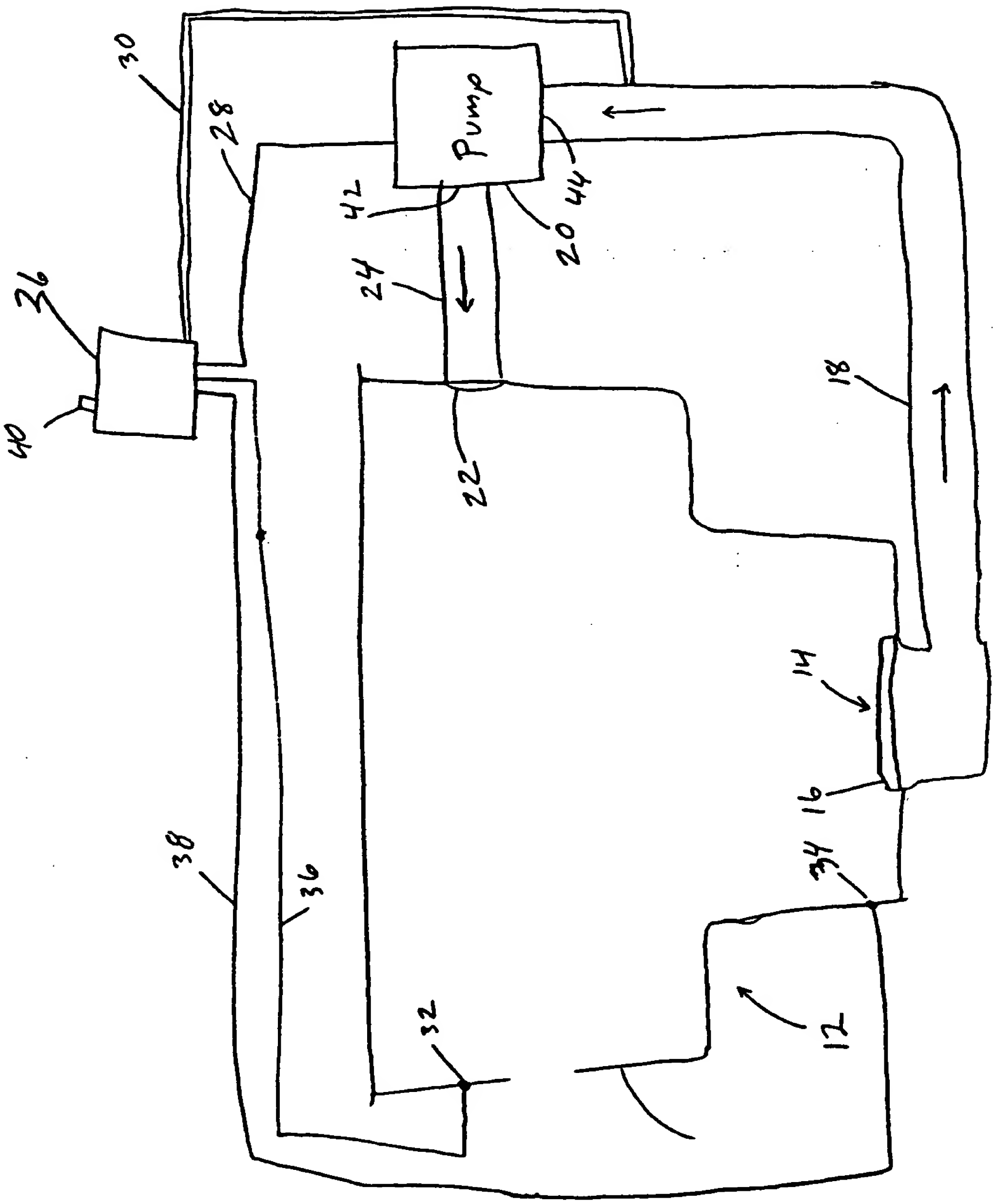


Fig. 1

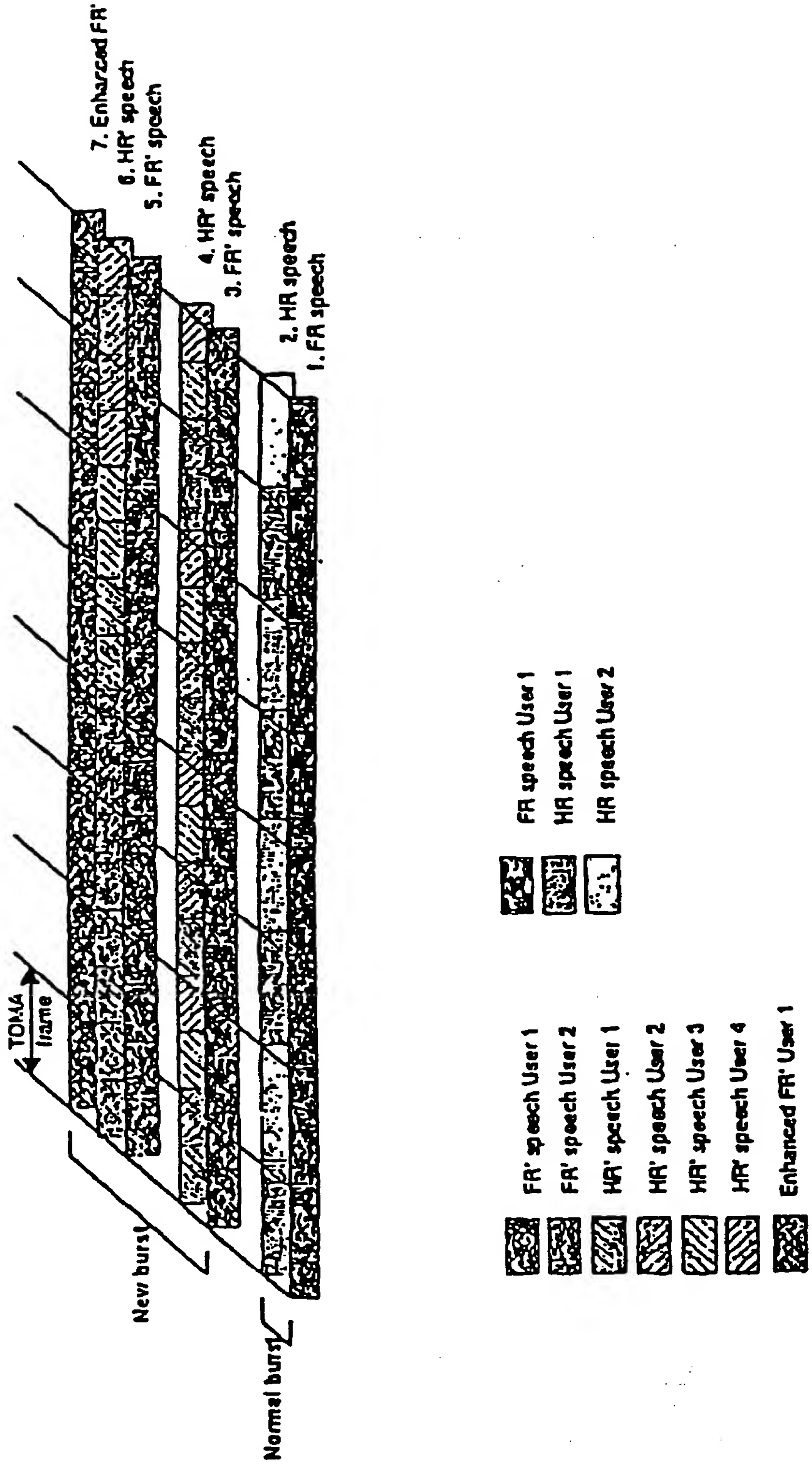
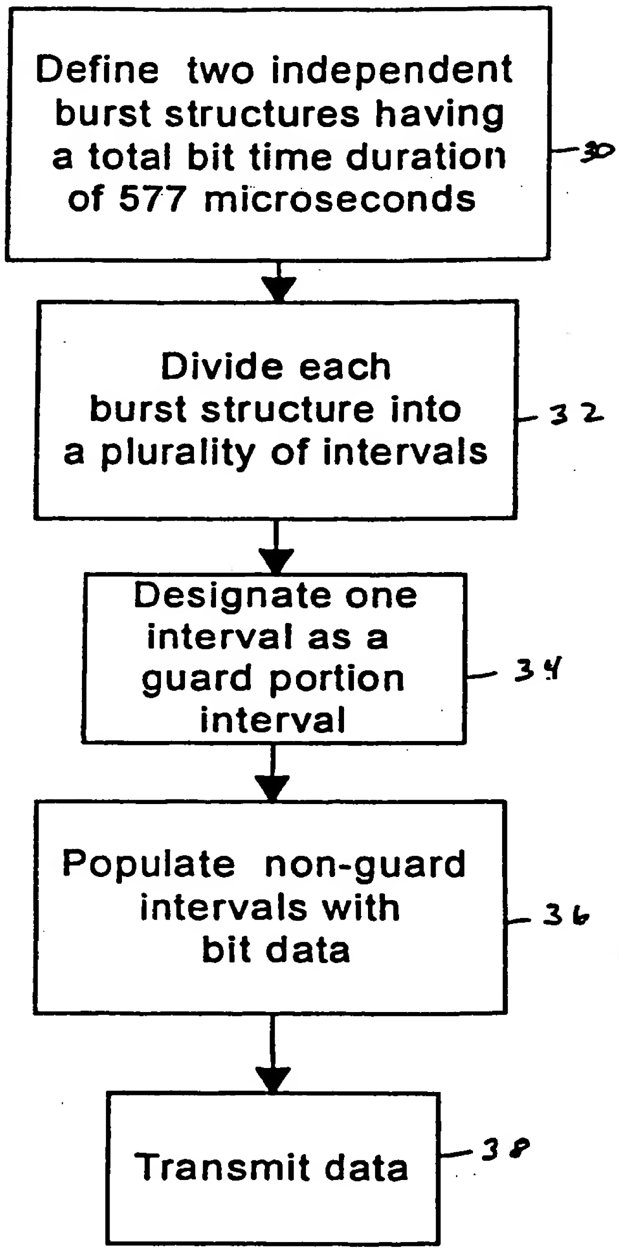


Figure 9. Mapping of FR' and HR'

Fig. 10


Define two independent burst structures having a total bit time duration of 577 microseconds
30
Divide each burst structure into a plurality of intervals
32
Designate one interval as a guard portion interval
34
Populate non-guard intervals with bit data
36
Transmit data
38

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